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ALLOWING FOR MACHINERY REPLACEMENT IN CALCULATING DEBT REPAYMENT ABILITY

by

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The criterion normally given the most weight in evaluating potential farm loans is repayment capacity. In assessing repayment capacity the borrower or lender determines the cash flow left for debt payments after subtracting all cash operating expenses and family living. If the repayment capacity thus calculated equals or exceeds the expected loan payments, the loan or loan structure is financially feasible. The implicit assumption made with these calculations is that future borrowing for machinery and other asset replacement can be handled through intermediate-term debt rollover.

When loan terms were short and interest rates were low, principal repayment on highly leveraged farms was normally high enough to allow financing of machinery replacement by intermediate-term debt rollover. A farmer who made a major investment in any one year could expect to repay sufficient principal on intermediate-term debt in the first year that (s)he could finance any needed replacement machinery by reborrowing that principal. This can be accomplished by extending the repayment period one more year into the future, and reestablishing the debt payments at their original level. Under these conditions, machinery or other asset replacement does not need to concern either the farmer or the lender at the time of a major investment or refinancing. However, as longer repayment periods are used and as interest rates rise (on even payment loans) annual first year principal payment declines. It has declined for many farm situations to the point where debt rollover will not finance machinery replacement. Therefore the historically used repayment capacity calculations consistently overestimate actual repayment capacity. Many lenders have recognized this phenomenon and have developed rather ad hoc methods for dealing with it, but both lenders and borrowers need a more accurate method for estimating cash requirements for replacement of a farm's capital stock, particularly machinery.

This paper reviews the current procedure used in calculating repayment capacity, explains why machinery is the capital stock of primary concern, discusses the magnitude of the problem using New York dairy farms as an example and suggests methods for incorporating capital stock maintenance in repayment calculations.

Current Procedures For Estimating Repayment Capacity

To estimate the repayment capacity of a business, historical balance sheet or income statement data are adjusted or budgets are developed to reflect the expected performance of the business after the loan is made. Generally, data for an average future year are used. The repayment capacity of the business is then determined by adding interest paid to, if it is included in the expenses, and subtracting estimated living expenses from, the net cash flow, as indicated for a hypothetical example shown in table 1.

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Table 1. HISTORICAL METHOD OF ESTIMATING REPAYMENT CAPACITY

Total Cash Receipts	$150,000
Total Cash Expenses	-100,000
Net Cash Flow	50,000
Interest Paid (Cash)	+10,000
Available for Debt Service, Family Living & Cash Investment	60,000
Cash Family Living	-20,000
Repayment Capacity	40,000

When no cash investment is made, repayment capacity is the amount of cash available to make principal and interest payments. To determine the financial feasibility of a particular loan or loan structure, the required principal and interest payments are compared to the repayment capacity. If repayment capacity equals or exceeds the required payments, the loan is financially feasible.

An implicit assumption of this procedure is that the projected repayment capacity would, on an average at least, be generated in each year for at least the period of the shortest term loan made. For example, if a loan package includes a 5-year nonreal estate loan and a 20-year real estate loan, it is assumed that operation of the business without additional change or new investment will produce the calculated repayment capacity in each of the first 5 years, or at least would average that level over the 5-year period.

Maintaining Capital Stock

In order for a business that has borrowed to the limit of its repayment capacity to operate without additional investment for the period of the shortest term loan, maintenance of the capital stock must be allowed for in the repayment capacity calculations. The four major categories of capital stock to be maintained are land, livestock, buildings, and machinery.

Land

Under normal cultural practices land does not wear out and, thus, maintenance is of little concern. Only such items as soil fertility and drainage need maintenance. Both of these are covered in cash expenses through lime and fertilizer purchases for soil fertility and labor and materials for the drainage system.

Livestock

For a business where livestock replacements are raised, the cost of maintaining inventories is included in annual cash expenses as part of the feed, vet, livestock expense, labor and other expense items. In this case, cash expenses for normal operation of the business include all the cash cost of raising sufficient replacements to maintain livestock numbers.

When part or all of the replacements are purchased, the costs of these replacements should be included as part of cash expenses. Care must be exercised to include the cost of those required to maintain breeding stock numbers. Historical farm data on purchased replacements frequently include purchases to increase breeding stock numbers. If livestock replacements are not included as part of cash expenses, the annual investment should be estimated and this investment allowed for in the same manner as is used for machinery (discussed below).

Buildings

The costs of maintaining the existing set of buildings are included under annual building repair expense and are therefore part of total cash expenses. Buildings are long-term investments that are replaced infrequently. The large size and infrequent nature of building investment implies that a new financial feasibility analysis should be conducted before major building investment is made. Even buildings that have deteriorated can normally be used for another three to seven years, without seriously affecting productivity. Since most farm businesses have significant intermediate-term loan volume which will be paid off within 7 years or less, replacement of buildings can wait until some of these loans are paid off. Repayment capacity will thus be freed up before further building investment is necessary.

Machinery

The costs of repairing the existing machinery inventory are included in annual cash expenses. If all or most of the machinery used by the business is new, repair expense might be expected to maintain machinery inventories for a few years. However, most farm businesses have an aged machinery set that results from a few purchases each year. To maintain that machinery, a few items will have to be purchased each year. Machinery inventory assessed at current market value makes up 15 to 25 percent of total farm investment on many dairy farms [1, 3]. The new cost of the inventory could be nearly twice its current value. Thus, the annual investment required to maintain machinery inventory is a significant sum that will use cash flow whether made with cash or borrowed capital.

Farmers making major capital investments sometimes include soon-to-be-replaced items as a part of the current investment. In these cases machinery purchases may be avoided for the first year of the new loan. However, since machines are often replaced when major repairs are needed [4], it is often hard to predict all of those that will need to be replaced in any one year. Some machinery investment may be required in the first year even when plans are made to avoid this.

The repayment capacity calculation explained above does not allow for replacement of existing machinery. If a loan is made where repayment capacity exactly equals the required loan payments, problems will develop at the time the first machine needs to be replaced. No cash has been set aside for machinery replacement and there is no excess repayment capacity available to allow debt financing of the machine. Since an existing machine is being replaced, repayment capacity will not expand as a result of the investment except for a possible marginal improvement due to new technology built into the new machine.

Historically, farmers and lenders have relied upon intermediate-term debt rollover to handle replacement machinery investment. However, as loan terms are lengthened and as both interest rates and machinery investments increase, rollover is no longer sufficient.

The Magnitude of the Problem

As farms become more mechanized machinery investment and, thus, machinery replacement costs increase. Inflation also contributes to increased cost of replacement. On January 1, 1980 the average dairy farm in Cornell's Farm Business Management program had $71,000 invested in machinery. During the 1979 year an invested $17,000 (24 percent of total investment) worth of new machinery was purchased. Furthermore farms that were roughly constant in size during the year (cow numbers changed by less than five during the year) bought machinery valued at 25 percent of that investment.

The level of machinery investment varies considerably from farm to farm (table 2). This variability includes both between farm and between year variation. The between farm variability is caused by the kinds of machinery owned (manure spreader vs. drag), the intensity of use (use of corn planter on 20 acres vs. 150 acres), the quality of machine use (use vs. misuse), the machinery repair practices and abilities of the operator (some people repair, others replace) and the machinery investment preferences of the operator (enough to get by vs. owning the biggest in the county). The year-to-year variability results from the uncertain nature of breakdowns which necessitate replacement and the differences in cost of various machines. In estimating the machinery investment requirements for an individual farm the between farm variability is accounted for by tailoring the estimate to the specific farm in question. Between year variability cannot be predicted and is best allowed for by estimating average future investment and having the lender committed to financing the above average year if it occurs before a below average year.

Table 2. RELATIONSHIP BETWEEN MACHINERY PURCHASES AND AVERAGE MACHINERY INVESTMENT 610 New York Dairy Farms, 1979

Machinery Purchases as a Percent of Average Machinery Investment	Percent of Farms	
	All Farms	Constant Size Farms[a/]
Under 10	15	17
10-19	27	26
20-29	24	27
30-39	15	14
40-49	10	8
50-59	4	4
60 and over	5	4

a/ 392 farms for which cow numbers changed by less than 5 cows during the year.

Historically, loan terms have been short enough and interest rates low enough that a farmer could expect to repay enough principal on intermediate-term debt each year so that any machinery purchases could be financed by re-borrowing the repaid principal, refinancing the unpaid principal and the re-borrowed principal over the original term, and resetting the required payment at its original level. This procedure worked well when the interest rate was 8 percent and the normal term three years. However, as both the normal term and the interest rate increased, the amount of principal repaid in the first year of a loan became quite small (table 3). The first year repayment is the only year of concern since that would be the maximum principal repayment in the limiting case where all (100%) of the principal paid was reborrowed (rolled over) each year. In that case each year would be the first year of a repayment scheme scheduled for the next, say, seven years. At the end of each year the repaid principal would be reborrowed, the term extended one year and the payments would remain constant.

Table 3. RELATIONSHIP BETWEEN LOAN TERMS AND FIRST YEAR PRINCIPAL REPAYMENT WITH MONTHLY PAYMENTS [a/]

Interest Rate	Loan Term (Years)				
	3	4	5	6	7
Percent	----------Percent of Original Principal----------				
8	31	22	17	14	11
10	30	21	16	13	10
12	29	21	16	12	10
14	29	20	15	11	9
16	28	19	14	11	8
18	28	19	14	10	8

[a/] The percent of original principal repaid with annual payments is identical in most cases and not more than one percent higher in any case presented.

Comparison of tables 2 and 3 shows that a large number of farmers would not be able to finance machinery purchases by intermediate-term debt rollover if their total intermediate-term debt was equal to their machinery investment. This is not an unusual debt level for dairy farms where livestock, as well as machinery, are financed with intermediate term debt.

The relationship between intermediate term debt and machinery purchases on New York dairy farms is shown in table 4. Of the farms with less than 40 percent equity over two-thirds would not be able to finance machinery replacement with debt rollover if their intermediate-term debt had a seven year term. At 12 to 14 percent interest rates the amount that could be rolled over is only 9 or 10 percent of total intermediate-term debt (table 3), but two-thirds of the farmers have machinery purchases that exceed 10 percent of intermediate-term debt (table 4). An even higher proportion of the farmers with 40-59 percent equity had machinery purchases that exceeded the amount that could be rolled over with 7 year intermediate loan terms.

Even with 5-year terms one-half of those with under 40 percent equity and two-thirds of those with 40-59 percent equity could not finance replacement machinery purchases with debt rollover.

Table 4. RELATIONSHIP BETWEEN ANNUAL MACHINERY PURCHASES AND DEBT WHICH COULD POTENTIALLY BE REFINANCED ANNUALLY 547 New York Dairy Farms, 1979 [a/]

Machinery Purchases as a Percent of Intermediate-Term Debt	Percent Equity				All Farms
	Under 40	40-59	60-79	80 and over	
	----------Percent of Farms----------				
Under 5	15	6	6	5	7
5-9	16	14	6	4	10
10-14	20	13	13	4	12
15-19	12	15	6	3	10
20-24	12	13	10	3	10
25-29	6	8	9	3	7
30-34	9	9	6	3	7
35 and over	10	22	44	75	37

[a/] Includes all farms with intermediate term debt which were included in Smith, S.F. Dairy Farm Management Business Summary, New York, 1979, A.E. Res. 80-16.

The above analysis shows that reliance upon debt rollover to provide the funds for machinery replacement will result in cash flow problems for a large number of farmers. For repayment capacity to serve its intended purpose, machinery replacement must be built into the repayment capacity calculations or into the way repayment capacity is used. Some creditors use the latter approach and require excess repayment capacity to cover exaggeration of net cash flow, machinery purchases and other unknowns. The problem with this method is the difficulty of determining how much excess capacity should be required. A more accurate approach is to incorporate machinery replacement into the repayment capacity calculations. While rollover can provide some funds, an accurate estimate of repayment ability requires that allowance be made for the cash required to provide the remainder of the funds needed.

Modified Replacement Capacity Procedures

Appropriate modifications of the replacement capacity formula depend on the expected method of operation of the business and the farmers current financial position. For example, setting aside cash for machinery purchases may be possible for some but impossible for others. A discussion of alternative approaches follow.

Cash Purchase

One approach to including machinery replacement in repayment capacity calculations is to assume that all machine purchases will be made with cash. This is the approach normally used for purchased livestock replacements. In this case the repayment capacity calculations can be simply modified by subtracting a cash machinery expense equal to the annual replacement machinery investment at the same time that living expenses are subtracted.

Annual replacement machinery investment is the average dollar value of new machinery that must be purchased each year to maintain the existing stock of machinery. For a stable business without recent change in size, annual machinery investment can be estimated as the average amount of machinery purchased during each of the past few years. Prices, however, must be adjusted to reflect inflation in machinery costs between the actual time of purchase and the year of the data being used to calculate repayment capacity.

For businesses where historical machinery purchase experience is unavailable or inappropriate, as is frequently the case with expanding changing businesses, average machinery investment can be estimated from current inventory. If the repayment capacity is being calculated because of or at the time of new investment in the business, the nonreplacement machinery purchased as a part of the new investment should be excluded from the current inventory for estimating machinery replacement costs as long as the life of the new investment exceeds the term of intermediate-term debt. Such machinery should not have to be replaced until after the cash flow position of the business improves. It is the currently existing inventory that must be maintained (replacement provided for). If the age of existing machinery is distributed approximately uniformly over the expected machinery life span, the market value of the existing machinery stock as a percent of its new price (V) can be calculated as:

$$V = \frac{1.00 + S}{2}$$

where S is the average value of machinery at the time it is traded in as a percent of the current new price of replacement. The new cost of the existing machinery set (N) is then:

$$N = \frac{CM}{V}$$

where CM is the current market value of the current machinery inventory. Using this procedure N is the replacement cost of the complete existing machinery inventory and may differ significantly from the original cost of that inventory since inflation has been accounted for. The percent of this new cost that must be purchased each year is calculated as:

$$P = \frac{1.00 - S}{Y}$$

where Y is the average life span of machinery. The average amount of machinery purchased each year or the annual replacement machinery investment (AR) is then calculated as P times N. These equations can be consolidated as:

$$AR = \left[\frac{CM}{\frac{1.0 + S}{2}}\right] \left[\frac{1.0 - S}{Y}\right]$$

For example, if the current machinery value is $100,000, salvage value is 20 percent and average life span is 8 years, the annual machinery investment required to maintain the capital stock

$$= \left[\frac{100{,}000}{\frac{1.0 + 0.2}{2}}\right] \left[\frac{1.0 - 0.2}{8}\right]$$

$$= (166{,}667)(.1) = \$16{,}667 .$$

In cases where recent expansion of the business has resulted in an unusually large number of nearly new machines, this procedure may overestimate machinery replacement needs in the first 1 to 3 years but underestimate needs after that.

Since values of Y and S generally vary over a narrow range, the values shown in table 5 can be substituted for equations, simplifying calculation of cash machinery investment. In the example, using an 8 year average life (Y) and a 20 percent market value as a percent of replacement cost (S), the annual investment required as a percent of current market value is 17 and, thus, annual replacement cost is $17,000 (100,000 x .17). This differs slightly from the calculated value ($16,667) due to rounding of the percentage numbers in table 5.

Table 5. ANNUAL INVESTMENT REQUIRED TO MAINTAIN MACHINERY INVENTORY

Average Life of Farm Machinery	Market Value at Time of Trade-in as Percent of Replacement Cost			
	10	20	30	40
	------% of current market value of machinery------			
5	33	27	22	17
6	27	22	18	14
7	23	19	15	12
8	20	17	13	11
9	18	15	12	10
10	16	13	11	9

If all replacement machinery is to be purchased with cash, repayment capacity is easily calculated once annual cash machinery investment is determined. As shown in the example in table 6, cash machinery investment is subtracted at the time cash living expenses are deducted.

TABLE 6. CALCULATION OF REPAYMENT CAPACITY WHEN REPLACEMENT MACHINERY IS PURCHASED WITH CASH

Available for debt service family living and cash investment	$60,000
Cash Living Expenses	-20,000
Cash Machinery Investment	-16,667
Repayment Capacity	$23,333

Debt Purchase - No Rollover of Outstanding Debt

Many businesses do not have sufficient net cash income to allow setting aside cash for needed machinery purchases. Also, attractive investment opportunities may lead some to prefer debt financing of new machine purchases. Under these conditions most or all new machinery purchases will be made with debt capital.

If refinancing is not occurring, and there is outstanding debt required to finance intermediate-term debt that will be maturing annually, the new replacement machinery may replace the maturing debt. This will leave a relatively constant amount of repayment capacity for other investments. Under these stable conditions the historical method of calculating repayment capacity outlined in the first section of this paper may provide a reasonable basis for lending. However, even in this case the annual repayment capacity (excluding cash machinery investment) should be compared to future loan payments on existing debt plus expected future machinery purchase debt for a 3 to 7 year period to be sure that cash flow problems will not result.

An example illustrating this procedure is shown in table 7. For this example, the machinery replacement requirement is $16,667 per year which will be financed at 12 percent over 5 years. In this case repayment problems can be expected in years 2 and 3 after which no debt will be maturing for a number of years.

Table 7. EFFECT OF FUTURE REPLACEMENT MACHINERY REPAYMENT REQUIREMENTS ON AVAILABLE REPAYMENT CAPACITY
No Refinancing of Existing Debt

Item	Year 1	2	3	4	5
Available for Debt Payment	$40,000	$40,000	$40,000	$40,000	$40,000
Debt Payments:					
Real Estate	16,000	16,000	16,000	16,000	16,000
Livestock Loan	8,000	8,000	8,000		
Machinery Loan 1	3,000				
Machinery Loan 2	5,000	5,000	5,000	5,000	
Machinery Loan 3	3,000	3,000			
Net Available	$ 5,000	$ 8,000	$11,000	$19,000	$24,000
Machinery Payments	4,624	9,284	13,872	18,496	23,120
Deficit or Surplus	$ + 376	$-1,284	$-2,872	$ + 504	$ + 880

When refinancing is planned, anticipated replacement machinery debt service requirements can be subtracted from repayment capacity as historically calculated to determine the cash flow available for other financing. If we assume that all machinery is purchased with debt capital, the required debt payments for machinery replacements can be calculated for each year for several years into the future. By subtracting these payments from repayment capacity as historically calculated the amount of repayment capacity available for repayment of other than machinery replacement debt can be determined. Expected payments will use up considerably less of the available repayment capacity the first year than would have to be set aside if all machinery replacement purchases were cash. However, the repayment burden will increase annually reaching a maximum X years in the future where X is the number of years over which machinery is financed. For example, return to our case where $16,667 of machinery must be purchased annually. The amount available for debt repayment without consideration to machinery replacement needs is $40,000 and machinery is financed over five years at 12 percent interest with annual payments. Repayment capacity available for existing and new debt is shown in table 8.

Table 8. EFFECT OF FUTURE REPLACEMENT MACHINERY REPAYMENT REQUIREMENTS ON AVAILABLE REPAYMENT CAPACITY
After Refinancing

Item	Year 1	2	3	4	5	6
Available for Debt Payment	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Machinery Payments	4,624	9,284	13,872	18,496	23,120	23,120
Repayment Capacity	$35,376	$30,752	$26,128	$21,504	$16,880	$16,880

The repayment capacity calculated in this manner can be compared to the repayment requirements of the planned loan structure to determine the point where cash flow problems will result. In our example a refinancing package that required debt repayment of $20,000 per year would result in repayment problems in year 5. Note that if this business paid for machinery with cash, no repayment problems would result (see table 6). The machinery repayment requirements when machinery is purchased with borrowed capital will always, at some point near the end of the machinery financing period, exceed the funds required when all replacements are purchased with cash. This occurs because of the interest cost of the debt capital.

If a business is being completely refinanced and the shortest planned term for any part of the loan package is 5 years, cash flow problems could result from making a loan based on repayment capacity calculated without consideration for replacement of the current machinery inventory (see table 7). For example, a loan with debt payments equal to $40,000 will have a deficit cash flow equal to machinery payments.

Debt Purchase - With Rollover

The annual future payments calculated above do not take into consideration the principal repayment and, thus, the debt rollover potential that is generated as debt is repaid. Since most farmers make machinery and/or breeding stock purchases each year, many lenders explicitly or implicitly plan to rollover intermediate-term debt each year. If only the replacement machinery debt is rolled over, the effect is a reduction in the rate of increase in the amount of cash flow used up by replacement machinery purchases (table 9).

Table 9. AMOUNT OF PAYMENT WITH ANNUAL DEBT ROLLOVER OF REPLACEMENT MACHINERY DEBT ONLY

Year	Amount Borrowed	Total Debt	Principal	Interest	Payment
1	$16,667	$16,667	$ 2,624	$ 2,000	$ 4,624
2	16,667	30,710	4,834	3,685	8,519
3	16,667	42,543	6,697	5,105	11,802
4	16,667	52,513	8,266	6,302	14,568
5	16,667	60,914	9,588	7,310	16,898
6	16,667	67,993	10,703	8,159	18,862
7	16,667	73,957	11,641	8,875	20,516
8	16,667	78,983	12,433	9,478	21,911
9	16,667	83,217	13,099	9,986	23,085
10	16,667	86,785	13,661	10,414	24,075
11	16,667	89,791	14,134	10,775	24,909
12	16,667	92,324	14,533	11,079	25,612
13	16,667	92,324	14,533	11,079	25,612
14	16,667	96,256	15,151	11,551	26,702
15	16,667	97,772	15,390	11,733	27,123
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
?	$16,667	$105,883	$16,667	$12,706	$29,373

Continued rollover of machinery replacement debt will ultimately result in a higher required annual payment than if rollover is not practiced (tables 8 and 9). However, the maximum occurs many years in the future and a borrower may be able to get other loans sufficiently paid down during the intervening period to be in a position to be able to handle higher payments when they come due.

Most businesses where repayment capacity calculations are critical will have other intermediate-term debt outstanding, either as a result of initial purchase of the business or for prior replacement machinery purchases. In this case, principal repayment on the entire intermediate-term loan volume would provide a basis for debt rollover and, thus, could be used to reduce the added payments required for replacement machinery.

For example, assume the farm business used above has $50,000 of existing machinery debt that is being refinanced over 5 years at 12 percent. As payments are made on the existing debt ($50,000), the principal repaid provides a basis for reducing annual payments by rollover. As indicated in table 10, the amount of additional debt repayment capacity used by replacement machinery purchases is considerably less than when there is no existing intermediate-term debt or such debt is not rolled over.

Table 10. EFFECT OF REPLACEMENT MACHINERY PURCHASE ON REPAYMENT REQUIREMENTS WITH ANNUAL ROLLOVER OF EXISTING INTERMEDIATE-TERM DEBT

Year	Amount Borrowed	Total Debt	Interest	Principal	Payments	Increase in payment due to Machinery
Without replacement machinery:						
1-5		$50,000			$13,871	0
With replacement machinery:						
1	$16,667	$58,796	$ 7,051	$ 9,260	$16,311	$ 2,440
2	16,667	66,203	7,944	10,421	18,365	4,494
3	16,667	72,449	8,694	11,404	20,098	6,227
4	16,667	77,712	9,325	12,233	21,558	7,687
5	16,667	82,146	9,858	12,930	22,788	8,917
6	16,667	85,883	10,306	13,159	23,825	23,824 a/
7	16,667	89,031	10,684	14,014	24,698	24,698
8	16,667	91,684	11,002	14,422	25,424	25,424
9	16,667	93,929	11,271	14,786	26,057	26,057
10	16,667	95,810	11,497	15,082	26,579	26,579
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
?	$16,667	$105,883	$12,706	$16,667	$29,373	$29,373

a/ Original debt not connected to machinery replacement ($50,000) would be paid off by this year if machinery purchase had not required rollover.

The higher the level of existing debt that can be rolled over, the lower the impact of replacement machinery on repayment requirements. (Compare tables 9 and 10.) If there is sufficient existing debt to be rolled over, it will be possible to completely finance replacement machinery purchases by rollover of existing debt. The level of existing debt (D) required to reach that status can be calculated using the following equation:

$$D = \frac{AR}{a-r}$$

where AR = Annual replacement machinery purchase ($);
r = the interest rate expressed as a decimal; and
a = annual debt repayment per $1 debt on intermediate (rollover) loans.
Using the example:

$$D = \frac{\$16,667}{.27741 - .12} = \$105,883$$

To place in perspective the level of existing debt required to allow complete financing of replacement purchases with rollover of debt, these debt levels are expressed as a percent of current machinery inventory value (table 11). In general, debt levels of this magnitude could not be made using only the existing machinery for security. This level could frequently be supported on many livestock farms where livestock inventories also provide security for intermediate-term debt. However, in many cases debt of the required magnitude could not be secured. Even if it could, continued rollover of debt to reach levels of that magnitude would be financially unsound unless large amounts of equity were being developed in short- or long-term assets during the rollover period.

Table 11. LEVEL OF OUTSTANDING DEBT REQUIRED FOR DEBT TO FINANCE FUTURE REPLACEMENT MACHINERY PURCHASES

Average Life of Machinery	Interest Rate and Term of Loan								
	3 Years			5 Years			7 Years		
	8%	12%	16%	8%	12%	16%	8%	12%	16%
	----------Percent of Current Machinery Inventory----------								
10% Salvage value on machinery:									
6 years	89	92	96	160	173	188	243	275	311
8 years	66	69	72	120	130	141	182	206	233
10 years	53	55	58	96	104	113	146	165	188
20% Salvage value on machinery:									
6 years	72	75	78	130	141	153	198	224	254
8 years	54	56	58	98	106	115	149	168	190
10 years	43	45	47	78	85	92	119	135	152
30% Salvage value on machinery:									
6 years	58	61	63	105	114	123	160	181	205
8 years	44	45	47	79	86	93	120	136	154
10 years	35	36	38	63	68	74	96	109	123

Implications for Financial Analysis

From the above discussion it is clear that (1) machinery replacement must be taken into consideration in analyzing repayment capacity and, (2) rollover of intermediate-term debt can provide the financing needed for some replacement machinery but for most farms cannot be relied upon to completely handle financing of machinery replacement.

The suggested procedure for adjusting repayment capacity to handle replacement machinery is to incorporate cash machinery investment into the repayment capacity calculation as indicated in table 6. Then the cash machinery investment is calculated using the following steps.

1. Calculate the expected annual replacement machinery investment from historical farm data or by using table 5.
2. Determine the amount of principal repaid during the first year on all intermediate-term loans that could be rolled over. The amount of intermediate-term debt that can be rolled over should be determined cooperatively by the borrower and lender. The proportion of that debt that will be repaid in the first year can be determined directly or estimated using table 3. Principal paid during the first year is the amount of replacement machinery investment that can be financed by adding its cost to the outstanding principal balance, extending the loan for one more year and refinancing without changing the repayment requirements. Since it is done each year, the amount of debt service requirements for this intermediate-term debt is constant over time.
3. Subtract 2 from 1. Calculated in this manner the repayment capacity calculated is sustainable indefinitely and debt levels will not increase from their current level.

For our example:

1. Annual replacement machinery investment is $16,667,
2. outstanding intermediate-term debt is $50,000; and
3. intermediate-term debt is financed over 5 years at 12 percent interest.

Annual intermediate-term debt principal repayment is estimated at $8,000 ($50,000 x .16 from table 3), leaving a cash machinery investment of $8,667 ($16,667 - $8,000). Repayment capacity is then calculated as shown in table 12.

Table 12. CALCULATION OF REPAYMENT CAPACITY INCORPORATING CASH MACHINERY INVESTMENT An Example

Available for debt service, Family living and cash investment	$60,000
Cash family living	-20,000
Cash machinery investment	- 8,667
Repayment Capacity	$31,333

Repayment capacity calculated in this manner represents the maximum that will be available on a sustained basis over the period over which machinery is financed except for cases where some loans not available for rollover mature earlier than new machinery loans or where income is expected to rise over the period. In both of these cases, the procedure presented in table 7 should be employed to determine if debt financing of all machinery purchases with no debt rollover will provide more repayment capacity for other investments.

When loans that cannot be rolled over mature before new machinery loans, the attendant reduction in repayment requirements may make it possible to handle a somewhat higher debt level by releasing repayment capacity to handle replacement machinery debt repayment when at its highest level.

For the example used above, assume that there was a 3 year, $25,000, 12% interest cattle loan that couldn't be rolled over. Under these circumstances debt financing of all the cash machinery investment would use less of the repayment capacity than cash purchase during the first three years and the released repayment capacity could cover the higher payments in year 4 and 5. For our example situation the maximum replacement machinery payment that was effective in limiting borrowing occurred in year 3 and was $7,320 rather than the $8,667 calculated without consideration to the cattle loan.

Table 13. EFFECT OF SHORTER TERM NON-ROLLOVER LOAN ON AVAILABLE REPAYMENT CAPACITY

Item	Year 1	2	3	4	5	6
Repayment Capacity	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Machinery Payments	2,440	4,880	7,320	9,760	12,200	12,200
Cattle Loan	10,409	10,409	10,409	-	-	-
Remaining Capacity	$27,151	$24,711	$22,271	$30,240	$27,800	$27,800

In cases such as this the repayment requirements in the most limiting year (year 3 in our example) should be used in estimating repayment capacity available for servicing other existing and new loans.

If income is expected to increase within the number of years represented by the term of machinery loans, repayment capacity calculations should be made for each different income level and calculations similar to tables 12 and 13 conducted. The changing repayment capacity may allow servicing a higher level of debt. In this case, it is inadvisable to calculate an average repayment for the entire period as one would to handle variability of income.

Impact on Dairy Farms

The suggested procedure impacts repayment capacity determination by incorporating machinery replacement. To illustrate, repayment capacity was calculated using both the old and the new procedure for the 610 New York dairy farms who participated in Cornell's Farm Business Management project in 1979. The calculations of repayment capacity were carried out using the following conditions and assumptions:

1. machinery replacement requirements are 23 percent of average machinery investment, the level experienced by Farm Business Management Cooperators during 1975-79;
2. all intermediate-term debt can be rolled over;
3. intermediate-term debt has a loan period of greater than one but less than 10 years;
4. credit terms for machinery purchases and intermediate-term debt rolled over are a) monthly payments and b) interest rate 12% (consistent with 1979 rates);
5. principal paid during the first year as a percent of outstanding loan volume is a) 29.4 for 3 year loans, b) 15.5 for 5 year loans and c) 9.7 for 7 year loans; and
6. living expenses are $7,650 per operator plus 4% of cash receipts.

For this group of farms, repayment capacity calculated under the old procedure exceeded the planned loan payments on 56 percent of the farms. With all intermediate-term debt rescheduled over 3 years, 57 percent of the farmers can make the payments (table 4). As the term over which loans are refinanced is lengthened to 5 and 7 years the proportion of farmers who can make their payments increases to 62 and 65 percent, respectively.

Table 14. ABILITY TO MEET SCHEDULED PAYMENTS IN FULL BY METHOD OF CALCULATING REPAYMENT CAPACITY 610 New York Dairy Farms, 1979

Period of Intermediate-Term Debt	Proportion of Farms for which Repayment Capacity Exceeds Scheduled Payment	
	Old Procedure	With Mach. Replacement
3 years	57	50
5 years	62	50
7 years	65	46

When machinery replacement is incorporated into the repayment capacity calculations the percent of farms who can make their payments declines from 50 percent when intermediate-term debt is financed over 3 years to 46 percent with a 7 year financing period. The decline in the amount of principal repaid in the first year (which becomes available for machinery purchase of financing) apparently offsets the reduction in annual repayment requirements attendant with extension of the repayment period from 3 to 7 years.

Under current financing terms where much intermediate-term debt is customarily financed over 7 years, approximately 20 percent of the farmers could be misled into thinking that they have sufficient repayment capacity to meet current debt service requirements when in fact they do not. For this group of people, payments could be made only if machinery investment were maintained at below average levels.

The magnitude of the impact of allowing for machinery replacement on a per farm basis depends on the level of machinery investment and the amount of intermediate-term debt that can be rolled over. However, the magnitude is frequently substantial (table 15). With a 7 year repayment period for intermediate-term debt, over 39 percent of the farms had reductions of over $10,000 in annual repayment capacity. The proportion of farms with large reductions is lower with 5 and 3 year repayment periods, but many of these farms have reductions of sufficient size to invalidate loan plans that require use of a high proportion of the farm's estimated repayment capacity.

Table 15. EFFECT OF MACHINERY REPLACEMENT ON REPAYMENT CAPACITY PER FARM 610 New York Dairy Farms, 1979

Reduction in Repayment Capacity per Farm	Period of Intermediate-Term Debt		
	3 years	5 years	7 years
(dollars)	----------Percent of Farms----------		
0	53	20	5
1 - 2,500	8	10	8
2,501 - 5,000	10	16	15
5,001 - 7,500	6	17	17
7,501 - 10,000	7	10	16
10,001 - 12,500	6	7	12
12,501 - 15,000	3	7	8
15,001 - 17,500	2	4	8
over 17,500	5	9	11

An alternate way of looking at the impact of this reduction in repayment capacity is to convert the repayment capacity estimates to maximum debt carrying capacity. To do this a representative set of credit conditions are assumed and the debt service requirement per dollar of debt implied by those credit conditions is divided into the repayment capacity to determine maximum debt. For the specific farms we are dealing with, the following must be added to the list of conditions and assumptions listed earlier.

7. When a farm borrows up to its maximum debt carrying capacity, long term debt makes up 55 percent of total debt and is financed over 25 years at 11.5 percent (1979 rates). Intermediate-term debt makes up 45 percent of total debt and is financed according to the terms indicated in number 4 above. Under these conditions the repayment capacity required per $1000 of debt is:

Amount	Period of Intermediate-Term Debt
$246.51	3 years
187.27	5 years
162.49	7 years

To eliminate the impact of size of business, the maximum debt per farm is divided by number of cows. The results of this analysis indicate that for the 610 farms the average maximum debt per cow is reduced by $250 to $850 per cow depending on the length of term over which intermediate-term debt is financed.

Table 16. EFFECT ON MAXIMUM DEBT PER COW OF INCLUDING MACHINERY REPLACEMENT IN ESTIMATING REPAYMENT CAPACITY
610 New York Dairy Farms, 1979

Reduction in Maximum Debt Per Cow	Period of Intermediate-Term Debt		
	3 years	5 years	7 years
(dollars)	----------Percent of Farms----------		
0	53	20	6
1 - 200	10	10	5
201 - 400	9	14	10
401 - 600	9	15	15
601 - 800	8	14	13
801 - 1,000	5	9	15
1,001 - 1,200	3	6	13
1,201 - 1,400	2	5	7
over 1,400	1	7	16
Average	255	562	858

For a number of years the Department of Agricultural Economics at Cornell has published tables indicating the relationship between debt carrying capacity and various management factors [5,6]. These data have always assumed that machinery replacement could be handled by refinancing and debt rollover. Tables 17 through 21 illustrate the impact of including machinery replacement in this analysis. As implied by the results presented above, the impact is greatest on farms where the intermediate-term debt repayment period is longest. However, the general relationship between business factors and repayment capacity is not changed.

Table 17. EFFECT OF MACHINERY REPLACEMENT ON DEBT CAPACITY PER COW BY RATE OF PRODUCTION 610 New York Dairy Farms, 1979

Production per cow	Period of Intermediate-Term Debt [a]					
	3 Years		5 Years		7 Years	
	with mach.	without mach.	with mach.	without mach.	with mach.	without mach.
(pounds)	maximum debt per cow					
less than 10,000	170	438	-6	576	-184	664
10,000 - 10,999	693	909	757	1197	682	1379
11,000 - 11,999	673	922	686	1213	605	1398
12,000 - 12,999	1095	1284	1246	1690	1236	1947
13,000 - 13,999	1184	1397	1340	1839	1321	2119
14,000 - 14,999	1509	1762	1750	2320	1800	2673
15,000 - 15,999	1527	1846	1769	2431	1834	2801
16,000 and over	2003	2294	2369	3020	2505	3481

[a] Only intermediate-term debt is varied. Long-term debt makes up 55 percent of total debt. Interest rate is 12 percent for short- and intermediate-term debt and 11.5 percent for long-term debt.

[b] Includes allowance for machinery replacement. Total machinery replacement is equal to 23 percent of average machinery investment. Cash machinery investment is total machinery investment minus the amount that can be financed by rollover of intermediate-term debt.

Table 18 EFFECT OF MACHINERY REPLACEMENT ON DEBT CAPACITY PER COW BY LEVEL OF LABOR EFFICIENCY 610 New York Dairy Farms, 1979

Milk per worker	Period of Intermediate-Term Debt a/					
	3 Years		5 Years		7 Years	
	with mach. b/	without mach.	with mach.	without mach.	with mach.	without mach.
(pounds)	maximum debt per cow (dollar)					
less than 250,000	411	708	348	931	213	1073
250,000 - 299,999	957	1243	981	1636	903	1885
300,000 - 349,999	1170	1448	1315	1906	1316	2196
350,000 - 399,999	1414	1668	1607	2196	1646	2531
400,000 - 449,999	1516	1751	1770	2305	1815	2657
450,000 - 499,999	1866	2082	2261	2740	2373	3158
500,000 - 599,999	1771	2023	2104	2663	2208	3069
600,000 and over	1770	1941	2170	2555	2330	2945

a/ Only intermediate-term debt is varied. Long-term debt makes up 55 percent of total debt. Interest rate is 12 percent for short- and intermediate-term debt and 11.5 percent for long-term debt.

b/ Includes allowance for machinery replacement. Total machinery replacement is equal to 23 percent of average machinery investment. Cash machinery investment is total machinery investment minus the amount that can be financed by rollover of intermediate-term debt.

Table 19. EFFECT OF MACHINERY REPLACEMENT ON DEBT CAPACITY PER COW BY COST CONTROL LEVELS 610 New York Dairy Farms, 1979

Feed and Crop Expense per cwt. milk	Period of Intermediate-Term Debt[a]					
	3 Years		5 Years		7 Years	
	with mach.[b]	without mach.	with mach.	without mach.	with mach.	without mach.
(dollars)	maximum debt per cow (dollars)					
Less than 3.00	1853	2169	2128	2853	2199	3288
3.00 to 3.49	1564	1850	1841	2435	1908	2806
3.50 to 3.99	1682	1960	1976	2580	2069	2973
4.00 to 4.49	1341	1569	1528	2065	1554	2380
4.50 to 4.99	1124	1399	1279	1842	1246	2123
5.00 to 5.49	969	1147	1061	1509	1008	1740
5.50 and over	564	790	561	1040	431	1198

[a] Only intermediate-term debt is varied. Long-term debt makes up 55 percent of total debt. Interest rate is 12 percent for short- and intermediate-term debt and 11.5 percent for long-term debt.

[b] Includes allowance for machinery replacement. Total machinery replacement is equal to 23 percent of average machinery investment. Cash machinery investment is total machinery investment minus the amount that can be financed by roll-over of intermediate-term debt.

Table 20. EFFECT OF MACHINERY REPLACEMENT ON DEBT CAPACITY PER COW BY SIZE OF BUSINESS 610 New York Dairy Farms, 1979

Herd size	Period of Intermediate-Term Debt [a]					
	3 Years		5 Years		7 Years	
	with mach.[b]	without mach.	with mach.	without mach.	with mach.	without mach.
(number cows)	maximum debt per cow (dollars)					
Less than 40	906	1236	982	1627	924	1875
40 - 54	1194	1502	1346	1977	1342	2278
55 - 69	1420	1654	1596	2178	1618	2510
70 - 84	1481	1722	1693	2266	1709	2612
85 - 99	1549	1706	1809	2245	1877	2588
100 - 114	1413	1596	1701	2075	1764	2391
115 - 129	1693	1958	2073	2577	2228	2970
130 - 149	1600	1778	1879	2341	1967	2697
150 and over	1603	1761	1932	2318	2045	2671

[a] Only intermediate-term debt is varied. Long-term debt makes up 55 percent of total debt. Interest rate is 12 percent for short- and intermediate-term debt and 11.5 percent for long-term debt.

[b] Includes allowance for machinery replacement. Total machinery replacement is equal to 23 percent of average machinery investment. Cash machinery investment is total machinery investment minus the amount that can be financed by roll-over of intermediate-term debt.

Table 21. EFFECT OF MACHINERY REPLACEMENT ON DEBT CAPACITY PER COW BY CAPITAL EFFICIENCY LEVEL 610 New York Dairy Farms, 1979

Capital Turnover	Period of Intermediate-Term Debt [a]					
	3 Years		5 Years		7 Years	
	with mach. [b]	without mach.	with mach.	without mach.	with mach.	without mach.
(years)	maximum debt per cow (dollars)					
Less than 2.00	1445	1675	1757	2205	1880	2541
2.00 - 2.49	1454	1689	1691	2224	1737	2563
2.50 - 2.99	1293	1590	1431	2093	1405	2412
3.00 - 3.49	1036	1281	1086	1686	990	1943
3.50 and over	682	1007	592	1326	442	1528

[a] Only intermediate-term debt is varied. Long-term debt makes up 55 percent of total debt. Interest rate is 12 percent for short- and intermediate-term debt and 11.5 percent for long-term debt.

[b] Includes allowance for machinery replacement. Total machinery replacement is equal to 23 percent of average machinery investment. Cash machinery investment is total machinery investment minus the amount that can be financed by rollover of intermediate-term debt.

Summary

Methods historically used to calculate the repayment capacity of farm businesses do not allow for maintenance of the entire farm capital stock. Necessary maintenance of most capital stock items is provided for in cash expenses. However, replacement of existing machinery is necessary and is not allowed for in the historical calculations.

When intermediate-term debt was customarily financed over a three year period the annual principal repayment was frequently great enough to allow financing of machinery replacement through debt rollover. Furthermore, many farmers could repair enough to "get by" for at least a year or two with considerably below average replacement purchases. However, as the repayment period for intermediate-term debt lengthened the annual principal repayment declined. Thus, the ability to "get by" for a year or two was of little value since such a procedure usually implies increased purchases in years three or four.

To correct the historical procedure's omission of machinery maintenance, the annual investment required to maintain the current machinery inventory should be estimated and the procedure should be modified to include this claim on available funds. This change involves determining the amount of machinery investment that could be funded each year by rollover of intermediate-term debt. This amount is then subtracted from estimated annual replacement investment. This gives the cash machinery investment that must be subtracted from available cash flow to determine repayment capacity.

In applying the new method to a group of New York dairy farms, the repayment capacity of 39 percent of the farms would have been over $10,000 lower than that estimated using historical methods if intermediate-term debt is financed over seven years. The average reduction was $9,700. About 20 percent of these farms would not have sufficient repayment capacity to meet debt service requirements when repayment capacity was estimated using the new procedure but would have sufficient capacity using the old methods. However, the general relationship between business management factors and repayment capacity is unchanged by this modification of the repayment capacity estimation procedure. Use of the modified procedures should help avoid debt repayment problems for a number of farmers.

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